

Key

1) What are the 3 principles of experimental design?

1) Control 2) Randomization 3) Replication

2) What does it mean when two variables are confounded?

- Their effects on a response variable are mixed together
- We can't determine if the response is due to trt. or another variable

3) What is the difference between subjects and individuals (or experimental units)?

humans      any other exp. units

4) We have 21 people that we need to assign to 3 different treatments (trt1, trt2, trt3). Use the section of the table of random digits below and assign the 21 people to the 3 treatment groups. List the numbers that are selected under each of the 3 headings below. **Clearly explain your procedure!!**

# 01-21

## TRT1

1. 08  
2. 12  
3. 02  
4. 17  
5. 18  
6. 19  
7. 21

## TRT2

1. 05  
2. 07  
3. 13  
4. 15  
5. 04  
6. 16  
7. 20

## TRT3

1. 01  
2. 03  
3. 06  
4. 09  
5. 10  
6. 11  
7. 14

## TABLE OF RANDOM DIGITS:

08768 11202 | 34859 09217 | 18194 45621 | 05078 66813 65461 50416 99742 08657

- assign subjects #01-21
- Read across table every 2 #'s
- first 7 numbers that show up (ignoring 22-99, 00) are trt. 1, next 7 are trt. 2, last 7 are trt. 3

5) What is the placebo effect?

When a subject responds (+ or -) to a placebo

6) What is the difference between a placebo and a control?

fake trt.

no trt. or old, proven trt.

7) What is a lurking variable?

a variable that we didn't measure in our study/expt. but that has an

8) An investigator wants to study the effects of two different fertilizers on plant growth (call them A and B).

There are 20 plots available to test the fertilizers on. The investigator will measure the amount of growth by the plants after 3 months.

a. What is the explanatory variable? **Fertilizer**

b. What are the treatments?

**Fertilizer A and B**

c. What is the response variable?

**amt. of growth after 3 months**

d. What are the individuals/subjects?

**20 plots of plants**

e. Do you think you should use a placebo group? How about a control group?

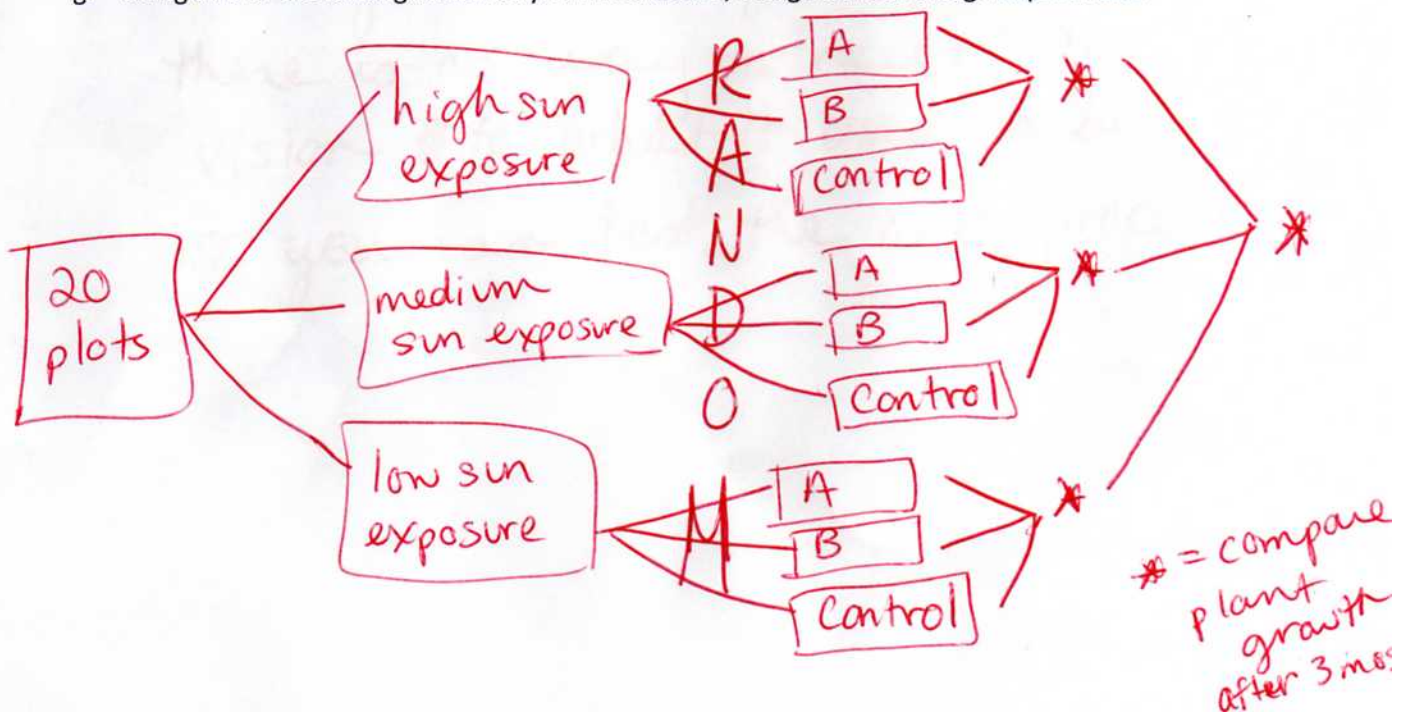
**no, no placebo effect possible**

**yes - see how plants grow naturally**

f. What are some lurking variables when it comes to plant growth?

**Sunlight, H<sub>2</sub>O, etc.**

g. Using one of the lurking variables you listed above, design a block design experiment:

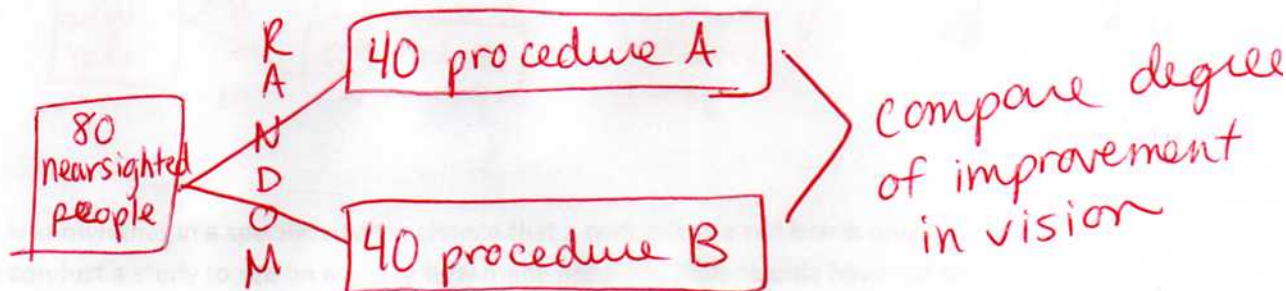


9) An investigator wants to study the effectiveness of two surgical procedures to correct nearsightedness. Procedure A uses cuts from a scalpel and procedure B uses a laser. The data to be collected are the degrees of improvement in vision after the procedure is performed. There are 80 nearsighted people available for the experiment.

- a. What is the explanatory variable? *the procedure*
- b. What are the treatments? *A and B*
- c. What is the response variable? *degree of improvement in vision*
- d. What are the individuals/subjects? *80 nearsighted people*
- e. Do you think you should use a placebo group? How about a control group?

*No, neither*

- f. Design a randomized comparative experiment:



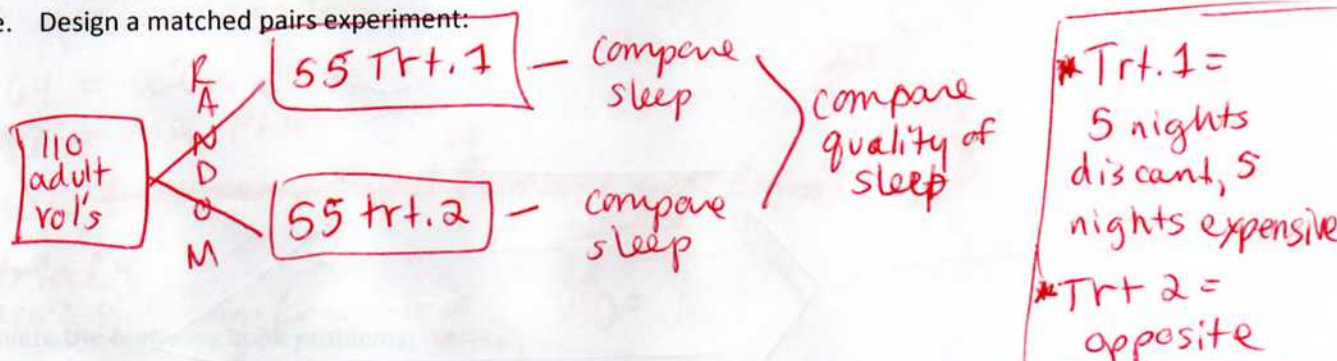
- g. There are two treatments. Why is it NOT ok to do a matched pairs design for this experiment?

*- once you do the first procedure there is no way to "reset" the vision to what it used to be so you can test the next procedure*



10) A researcher wants to see if more expensive mattresses really give a better night's sleep than the discount mattress brand. So they recruit 110 adult volunteers to participate in their study. They will have the adults sleep on the mattresses for 10 nights and then rank their overall quality of sleep (due to the mattress only).

- What is the explanatory variable? *mattresses*
- What are the treatments? *expensive & discount mattresses*
- What is the response variable? *quality of sleep*
- What are the individuals/subjects? *110 adult volunteers*
- Design a matched pairs experiment:



11) It is known that in a specific city the chance that a person has a red hair is only 1 in 7. A researcher wants to conduct a study to see on average how many people in Philadelphia have red hair in a sample of 5 people. Write instructions for a simulation and conduct 10 trials. Clearly label each trial and state your conclusion for the average number of people with red hair in Philadelphia.

58280 17867 07990 85055 55279 83390 37598 93350 05666 55402  
 87042 55080 76135 19947 79551 77594 87381 99430 44251 30896  
 72183 39856 94385 55160 50680 68443 95437 74302 06204 71004  
 76768 16066 94109 90685 92058 81744 99133 36354 34292 90092  
 21703 64616 03431 47610 31968 61593 36259 70600 53491 95542  
 78269 12087 32204 81177 30333 83630 06026 89308 94179 54907

- Outcomes are red hair or not
- Generator is Table of Random Digits
- Assign ~~0000~~ 1 = red hair 2-7 = other hair color, ignore 0, 8, 9.
- 5 #'s is a trial
- 10 trials total
- Record # w/ red hair out of 5

$$\text{Avg} = \frac{4}{10} = 0.40 \text{ people out of 5}$$

#	# red hair
0	
1	
2	
3	
4	
5	



- 12) The World Series ends when a team wins 4 games. Suppose that sports analysts consider the Phillies to have a 65% chance of winning any individual game over their opponent. Estimate the likelihood that the underdog team (not the Phillies) wins the series. Write instructions for a simulation and conduct 10 trials. Clearly label each trial and state your conclusion.

58280 17867 07990 85055 55279 83390 37598 93350 05666 55402  
 87042 55080 76185 19947 79551 77594 87381 99430 44251 30896  
 72183 39856 94385 55160 50680 68443 95437 74302 06204 71004  
 76768 16066 94109 90685 92058 81744 99133 36354 34292 90092  
 21703 64616 03431 47610 31968 61593 36259 70600 53491 95542  
 78269 12087 32204 81177 30333 83630 06026 89308 94179 54907

- Outcomes are win/lose for Phils
- TRD as generator
- 00-64 = win Phils  
65-99 = lose Phils
- go until ~~7 games played~~ <sup>or</sup> someone gets 4 wins
- 10 trials

Phils wins	#
0	
1	
2	
3	1
4	

- 13) Complete the following book problems: <sup>Record Phils wins (or winner of series)</sup>

p. 288-291 #9, 13, 18, 19, 26, 35, 36

(for #35 & 36, list possible sources of bias with the sampling method listed)

- 9) a) bar patrons  
b) % of people who think drinking & driving is a serious problem  
c) bar patrons @ the selected bar  
d) every 10<sup>th</sup> person selected  
e) systematic sample  
f) only one bar - undercoverage  
response bias - the patrons were leaving the bar when asked

- 18) a) vol. response sample + vol. resp.  
b) still vol. response  
c) multistage, then cluster.  
Still vol. response bias or nonresponse  
d) systematic. Possible nonresponse

- 19) a) multistage sample  
b) nonresponse, vol. response

- 13) a) all bags produced  
b) avg. weight of all bags, % passing inspection  
c) all ~~cases~~ <sup>bags</sup> from daily production  
d) 10 cases randomly selected, 1 bag in each  
e) ~~multistage~~ multistage sample  
f) unbiased

- 26) a) fairly unbiased  
b) biased toward "yes" because of "great tradition"

over →

- (35) a) basically unbiased. some nonresponse error  
b) cluster sample. somewhat biased - the one page may not be representative of all ~~businesses~~ <sub>businesses</sub>. also nonresponse error.

- (36) a) possible nonresponse. bad census.  
possible bias by asking to sign petition.  
b) bias by standing in cafeteria to take sample (undercoverage also)  
nonresponse/voluntary response  
bias b/c used largest cafeteria  
~~cafeteria~~



**MULTIPLE CHOICE:**

The next three questions concern this situation: Does using a cell phone while driving make an accident more likely? Researchers compared telephone company and police records to find 699 people who had cell phones and were also involved in an auto accident. Using phone billing records, they compared cell phone use in the period of the accident with cell phone use the same period on a previous day. Result: the risk of an accident was 4 times higher when using a cell phone.

1. This study is

- (a) a randomized comparative experiment.
- (b) an experiment, but without randomization.
- (c) a simple random sample.
- (d) an observational study, but not a simple random sample.

2. The explanatory variable in this study is

- (a) whether or not the subject had an auto accident.
- (b) whether or not the subject was using a cell phone.
- (c) the risk of an accident.
- (d) whether or not the subject owned a cell phone.

B

3. An example of a lurking variable that might affect the results of this study is:

- (a) whether or not the subject had an auto accident.
- (b) whether or not the subject was using a cell phone.
- (c) whether or not the subject was talking to a passenger in the car.
- (d) whether or not the subject owned a cell phone.

11. Confounding often defeats attempts to show that one variable causes changes in another variable.

Confounding means that

- (a) this was an observational study, so cause and effect conclusions are not possible
- (b) the effects of several variables are mixed up, so we cannot say which is causing the response
- (c) we don't know which is the response variable and which is the explanatory variable
- (d) we would get widely varied results if we repeated the study many times

The next six questions concern this situation: Want to stop smoking? Nicotine patches may help, and so may taking a drug that fights depression. A report in a recent issue of the *New England Journal of Medicine* describes a study of what works best. Here is part of the summary:

Use of nicotine replacement therapies and the antidepressant bupropion helps people stop smoking. We conducted a double-blind, placebo-controlled comparison of sustained-release bupropion (244 subjects), a nicotine patch (244 subjects), bupropion and a nicotine patch (245 subjects), and placebo (160 subjects) for smoking cessation.

**Results.** The abstinence rates at 12 months were 15.6 percent in the placebo group, as compared with 16.4 percent in the nicotine patch group, 30.3 percent in the bupropion group, and 35.5 percent in the group given bupropion and the nicotine patch.

17. How many treatments did this experiment compare?

- (a) two.
- (b) three.
- ☒ (c) four.
- (d) can't tell from the information given.

18. The response variable in this experiment is

- (a) the combination of drug (bupropion or placebo) and nicotine patch.
- (b) 893 people who want to quit smoking.
- (c) bupropion.
- ☒ (d) whether or not a subject was able to abstain from smoking for a year.

19. One group received a placebo. Why not just give this group no treatment at all?

- (a) It is not ethical to give no treatment at all in this setting.
- ☒ (b) Just thinking you are getting a treatment may have an effect, and we want to see if the real treatments do better than this.
- (c) A placebo is the same thing as no treatment at all.
- (d) Subjects would be disappointed if not given a pill.

20. The experiment was "double-blind." This means that

- ☒ (a) neither the subjects nor the people who worked with them knew whether they were taking bupropion or placebo.
- (b) the subjects did not know that the treatments were intended to reduce their smoking.
- (c) the subjects did not know whether they were taking bupropion or placebo.
- (d) subjects were not allowed to see cigarette ads.

21. The subjects of the study included both men and women. All of the subjects were randomly assigned among all the treatments with one use of the table of random digits. This design is called

- (a) a simple random sample
- ☒ (b) a completely randomized design.
- (c) a matched pairs design.
- (d) a block design.



22. The subjects of the study included both men and women. If the men and women were separately assigned to treatments, using the table of random digits twice, the design would be

- (a) a simple random sample
  - (b) a completely randomized design.
  - (c) a matched pairs design.
  - ☒ (d) a block design.
- 

35. In an experiment to see if aspirin reduces the chance of having a heart attack, a placebo is

- (a) the place where the subjects go when they have a heart attack
- ☒ (b) a dummy pill that looks like aspirin but has no active ingredients
- (c) a procedure for deciding who gets the aspirin treatment
- (d) the margin of error
- (e) 95%

36. Ethical standards for randomized, controlled clinical trials include

- ☒ (a) not asking subjects to agree to participate without first informing them of the nature of the study and possible risks and benefits.
- ☒ (b) insuring that each subject knows which treatment he or she received.
- ☒ (c) allowing subjects to decide whether or not to be in the control group
- (d) never testing drugs which have not been proven to be completely safe.
- (e) All of the above.

52. You work for an advertising agency that is preparing a new television commercial to appeal to women. You have been asked to design an experiment to compare the effectiveness of three versions of the commercial. Each subject will be shown one of the three versions and then asked her attitude toward the product. You think there may be large differences between women who are employed and those who are not. Because of these differences, you should use

- (a) a completely randomized design.
- (b) a categorical variable.
- ☒ (c) a block design.
- (d) a matched pairs design.
- (e) a multistage sample.

55. Corn variety #1 yielded 140 bushels per acre last year at a research farm. This year, corn variety #2, planted in the same location, yielded only 110 bushels per acre. Unfortunately, we don't know whether the difference is due to the superiority of variety #1 or to the effect of this year's drought. This is an example of

- (a) bias due to voluntary response.
- (b) random sampling error.
- ☒ (c) confounding.
- (d) the placebo effect.
- (e) nonsampling error.

75. Two essential features of all statistically designed experiments are

- (a) compare several treatments; use the double-blind method.
- ☒ (b) compare several treatments; use chance to assign subjects to treatments.
- (c) always have a placebo group; use the double-blind method.
- (d) use a block design; use chance to assign subjects to treatments.

97. The essential difference between an experiment and an observational study is

- (a) observational studies may have confounded variables, but experiments never do.
- (b) in an experiment, people must give their informed consent before being allowed to participate.
- (c) observational studies are always biased.
- (d) observational studies cannot have response variables.
- ☒ (e) an experiment imposes treatments on the subjects, but an observational study does not.

103. In a randomized block design the blocks often represent levels of

- ☒ (a) a lurking variable suspected of being confounded with the explanatory variable.
- (b) the explanatory variable.
- (c) the response variable.
- (d) placebo dosage.

24. The drug manufacturer Merck recently stopped testing a promising new drug to treat depression. It turned out that in a randomized, double-blind trial a dummy pill did almost as well as the new drug. The fact that many people respond to a dummy treatment is called

- (a) confounding
- (b) nonresponse
- (c) comparison
- ☒ (d) the placebo effect